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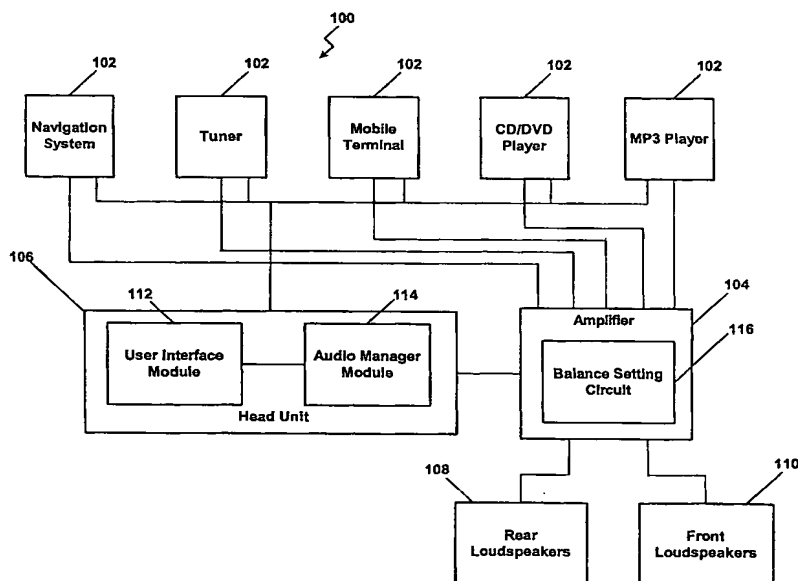
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For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: AUDIO SYSTEM WITH BALANCE SETTING BASED ON INFORMATION ADDRESSES



(57) Abstract: An audio system for a vehicle that includes a system for allowing an occupant of the vehicle to adjust a balance setting of each audio source (116). The audio system includes a plurality of audio sources (102) that are connected to an amplifier (104). The amplifier is connected to a head unit (106) that adjusts the balance setting of each audio source based on predetermined parameters or user preferences (112). Audio output signals from the audio sources are thus reproduced with different balance settings.

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## AUDIO SYSTEM WITH BALANCE SETTING BASED ON INFORMATION ADDRESSES

### BACKGROUND OF THE INVENTION

#### 1. Technical Field.

[01] This invention relates to vehicle audio systems and, more particularly, to a multi-channel audio system with a balance setting based on each type of audio source.

#### 2. Related Art.

[02] Motor vehicles are currently being equipped with a wide range of audio sources. The audio sources are used for a wide range of audio, communication and driver information systems that provide varying types of acoustic information to occupants of the motor vehicle. For example, the audio sources can be used to generate acoustic driver recommendations from a navigation system, vocal instructions from a speech controlled system, audio outputs from different audio sources (radio tuner, CD/DVD player, MP3 player), traffic messages, telephone conversations and synthetic speech outputs for reading email to name a few.

[03] The audio sources that are located in the motor vehicle may generate output signals that are meant for different listeners in the motor vehicle. For instance, whereas instructions from the navigation system and traffic messages are primarily of the driver's interest; a concurrently played CD for the children in the back seat of the vehicle is likely only of interest to the children sitting in a back seat for example. The driver or children may not want to interrupt the music being played from the CD with acoustic driver recommendations from the navigation system.

[04] Currently, the balance setting of speakers in the motor vehicle can only be set concurrently for all audio sources. As such, a need exists for an audio system that is capable of having balance settings for each type of audio source that is used in the motor vehicle.

## SUMMARY

[05] A multi-channel audio system for a vehicle is disclosed that includes a menu-driven user interface for setting the speaker balance setting based upon the type of audio source that generates an audio output signal. The multi-channel audio system includes a plurality of audio sources that may be selected from a wide range of audio sources that are capable of being placed in the vehicle. The audio sources are connected to a head unit and an amplifier. The head unit is the component in the vehicle that is used for audio management. Software modules on the head unit allow the occupant to use the audio sources located in the vehicle and manage such things as balance and volume. The head unit allows an occupant of the vehicle to adjust the balance setting for a plurality of speakers based upon each audio source or type of audio source.

[06] The head unit includes a user interface module and an audio manager module. The user interface module includes an application that generates a balance setting graphical user interface ("GUI") on a display of the multi-channel audio system. The balance setting GUI allows the occupant of the vehicle to adjust balance settings for each type of audio source that is capable of providing an audio output signal to the amplifier. The audio manager module is an application operable to set the balance setting in the amplifier for each audio source based upon the user's predefined settings.

[07] The user interface also provides a passenger GUI that allows the user to setup the multi-channel audio system based on a passenger information address. In other words, the multi-channel audio system allows the user to adjust the balance setting based upon the location of certain types of passengers in the vehicle. The user can identify interest groups (driver, co-driver, children, backseat, etc.) and set the balance setting for each of these interest groups. For example, if the children normally sit in the backseat, the user can adjust the balance setting of each audio source that the children want to hear to reproduce audio outputs in only the rear loudspeakers or only in a selected subset of loudspeakers.

[08] The amplifier is used to audibly reproduce outputs provided by the various audio sources on various combinations of loudspeakers that are located in the vehicle.

The amplifier includes a balance setting circuit that allows the amplifier to control the balance settings of the output signals that are provided by the audio sources. The audio manager module controls the balance setting circuit in the amplifier to operate as defined by the occupant for each audio source or type of source.

[09] Other systems, methods, features and advantages of the invention will be, or will become, apparent to one with skill in the art upon examination of the following figures and detailed description. It is intended that all such additional systems, methods, features and advantages be included within this description, be within the scope of the invention, and be protected by the following claims.

#### BRIEF DESCRIPTION OF THE DRAWINGS

[10] The invention can be better understood with reference to the following drawings and description. The components in the figures are not necessarily to scale, emphasis instead being placed upon illustrating the principles of the invention. Moreover, in the figures, like reference numerals designate corresponding parts throughout the different views.

Fig. 1 is a block diagram of an audio system that includes a balance setting system for multiple audio sources.

Fig. 2 is a GUI illustrating an example driver information screen.

Fig. 3 is a GUI illustrating an example audio information screen.

Fig. 4 is a block diagram illustrating the method steps taken to adjust balance settings in the audio system.

Fig. 5 is a block diagram illustrating the method steps taken to adjust balance settings in the audio system based on passenger categories.

Fig. 6 is a block diagram of an audio system that includes a balance setting system for multiple audio sources based on passenger categories.

#### DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[11] Fig. 1 discloses a multi-channel audio system 100 for a vehicle that is capable of allowing an occupant of the vehicle to adjust and set speaker balance settings based on the type of audio source that is providing an output. The balance

setting allows the multi-channel audio system 100 to reproduce audible output signals from each audio source in a predefined number of speakers in the vehicle. When more than one audio source is generating an output on the speakers, the multi-channel audio system 100 is capable of simultaneously applying multiple balance settings to the audio outputs that are generated on the speakers.

[12] The multi-channel audio system 100 includes a plurality of audio sources 102 that are connected to an amplifier 104. A set of rear loudspeakers 108 and a set of front loudspeakers 110 are connected to the output of the amplifier 104. Additional sets of loudspeakers also could be connected to the output of amplifier 104. Several different types of audio sources may be used in the multi-channel audio system 100. The audio sources 102 may be selected from a group of audio sources including, but not limited to, a navigation system, a radio tuner, a mobile or remote terminal (telephone), a CD/DVD player, a Radio Data System (RDS) tuner, an Internet radio, a cassette player, a satellite radio, a text-to-speech system, a television tuner or an MP3 player. Some of the audio sources 102 are illustrated in Fig. 1, but other audio sources may be a part of the multi-channel audio system 100 as well.

[13] The multi-channel audio system 100 also includes a head unit 106 that is connected to the amplifier 104. The head unit 106 may include a GUI module 112 that is operable to generate a GUI on a display. As set forth in greater detail below, the GUI module 112 is used by an occupant of the vehicle to adjust and set the balance settings of the rear and front loudspeakers 108, 110 and to review the balance settings that have already been programmed by the occupant and stored in the head unit 106. An audio manager module 114 is also included in the head unit 106 that is used to set the balance of the amplifier 104 for each respective audio source 102. In other embodiments, the head unit 106 may be connected to each one of the audio sources 102 or selected audio sources 102. This allows the head unit 106 to control operation of each of the audio sources 102.

[14] The amplifier 104 includes a balance setting circuit 116 that sets the balance of the speakers 108, 110 based upon user settings that are input into the GUI 112. Although not illustrated, the amplifier 104 also includes control circuitry and amplification circuitry that are designed to audibly reproduce audio output signals in the loudspeakers 108, 110 based on the user defined balance settings for the audio

sources 102. The audio manager module 114 is programmed to control the balance setting circuit 116 of the amplifier 104 based on the settings that are determined and input by an occupant of the vehicle.

[15] In Fig. 2, an illustrative balance setting GUI 200 that may be generated by the GUI 112 is set forth. The balance setting GUI 200 illustrated is used to set the balance for the driver of the vehicle. The balance setting GUI 200 includes a driver information screen tab 202, an audio screen tab 204, and a voice screen tab 206. Although not specifically illustrated, the multi-channel audio system 100 includes a display that is used to display information to occupants of the vehicle or users of the multi-channel audio system 100. The display would be connected to the head unit 106. The display is preferentially a touch-screen display that allows the user to interact with settings that are generated on the display. Other mechanical adjustment instruments for controlling the balance setting options provided by the head unit 106 may also be used such as buttons, knobs or switches.

[16] Activation of the driver information screen tab 202 brings up a driver information screen 208 that is generated by the GUI application or module of the user interface module 112. The driver information screen 208 includes a balance information GUI 210 and a balance setting GUI 212. The balance information GUI 210 includes a list of the respective audio sources 102 that are controlled by the settings contained in the balance setting GUI 212 of the driver information screen 208.

[17] In the example in Fig. 2, the balance information GUI 210 of the driver information screen 208 includes all of the audio sources 102 in the multi-channel audio system 100 that provide acoustic driver recommendations to the driver. As illustrated, the balance information GUI 210 includes navigation acoustic driver recommendations that may be generated from the vehicle navigation system and traffic notices that may be generated by the RDS tuner. RDS is a series of enhancements for VHF and FM radio that started in Europe and migrated around the world. It provides a variety of features including a more precise way of tuning and an eight-character display of the station. For car radios, it provides traffic information as well as a way to tune in alternate frequencies for the same station.

[18] The balance setting GUI 212 of the driver information screen 208 also includes a horizontal adjustment bar 214 and a vertical adjustment bar 216. An occupant of the vehicle can adjust the balance setting between the rear and front loudspeakers 108, 110, by using the horizontal adjustment bar 214. The vertical adjustment bar 216 is used to adjust the balance setting between the right-hand and left-hand side of the vehicle. In other words, the vertical adjustment bar is used to adjust the balance setting between the left and right loudspeakers of the rear and front loudspeakers 108, 110.

[19] During operation, the occupant of the vehicle can adjust the balance setting by moving the horizontal and vertical adjustment bars 214, 216 to the desired location. For illustrative purposes only, the balance setting set forth in Fig. 2 has the audio outputs from the navigation system and the RDS tuner set to be audibly reproduced only on the driver side speaker. The horizontal and vertical adjustment bars 214, 216 may be adjusted to audibly reproduce acoustic driver recommendations on all of the speakers or just one of the speakers. The settings of the horizontal and vertical adjustment bars 214, 216 causes the audio manager module 114 to adjust the balance setting of the audio sources 102 such that the audio output signals that are generated by the various audio sources 102 are set to the balance setting reflected in the balance setting GUI 212.

[20] Also in Fig. 2, the balance setting GUI 200 that is illustrated may be tailored to the driver of the vehicle. The multi-channel audio system 100 allows the balance setting to be setup based on passenger information addresses. The head unit 106 may be operable to allow the user of the multi-channel audio system 100 to set the balance setting for audio sources 102 for groups of interest, such as a driver, a co-driver or passenger, children, and adult passengers. Although not specifically illustrated, the GUI 112 may use a menu-based selection GUI to allow the user to select which group the balance setting GUI 200 is brought up during operation. Other selection methods for selecting the group of interest may also be used, such as buttons or knobs on the head unit 106.

[21] Fig. 3 illustrates a balance setting GUI 200 that may be used by children. Selection of the audio screen tab 204 causes the user interface 112 of the head unit 106 to generate an audio information screen 300. The audio information screen 300

may control the balance settings for various audio sources 102 that are directed toward entertainment and not vehicle navigation or driver information. As illustrated, the balance information GUI 210 sets forth that the audio information screen 300 is used to control the balance setting for the tuner or radio, a television, a CD/DVD player, a cassette player and an MP3 player. As with the driver information screen 208, the horizontal and vertical adjustment bars 214, 216 of the balance setting GUI 212 are used to control and adjust the balance settings for the audio sources 102 that fall in this category. In the example set forth in Fig. 3, the balance setting is set to cause the multi-channel audio system 100 to audibly reproduce audible output signals from these audio sources 102 equally on both of the rear loudspeakers 108.

[22] Although not illustrated, the voice screen tab 206 is used to set the balance setting of various voice-related audio sources 102. Selection of the voice screen tab 206 will generate a voice information screen. As with the examples set forth above, the horizontal and vertical adjustment bars 214, 216 of the balance setting GUI 212 are used to control and adjust the balance setting for the various audio sources 102 that fall in this category. Types of audio sources that fall in this category may be a mobile terminal or a text-to-speech system.

[23] An occupant of a vehicle may adjust the balance settings for several audio sources 102 instead of having one balance setting for all audio sources 102. In addition, the balance setting for the audio sources 102 to be adjusted based on groups of interest. This allows the occupant of the vehicle to control what speakers audio outputs are generated on such that different speakers 108, 110 can be used for different audio sources 102. For example, the balance setting for a navigation system can be setup to only generate acoustic driver recommendations and information on a speaker close to the driver while the balance setting for a CD player can be setup to play audio outputs on speakers in the back seat where children may be located. The children may not want to hear the acoustic driver recommendations generated by the navigation system and may want music from the CD player to continue uninterrupted. Such capability is supplied to the multi-channel audio system 100 by providing balance settings for each audio source 102.

[24] Fig. 4 is a block diagram that sets forth steps that may be taken by the multi-channel audio system 100 to control the balance settings of the audio sources 102 in



the multi-channel audio system 100. At step 400, the audio sources 102 generate a plurality of audio output signals. After the audio output signals are generated by the audio sources 102, they are transmitted to the amplifier 104, as is illustrated at step 402. The head unit 108 is used to adjust the balance settings for the audio output signals that are generated by the audio sources 102 and provided to the amplifier 104 at step 404. After the balance settings are adjusted for the audio output signals, they are reproduced on speakers 108, 110 according to the balance settings that are controlled by the head unit 106, as is illustrated at step 406.

[25] Referring to Fig. 5, another block diagram is set forth illustrating the steps that may be taken to adjust the balance settings of the audio sources 102 based upon passenger categories. At step 500, the user or driver of the vehicle selects a passenger category using the head unit 106. The passenger category may be selected using the balance setting GUI 200 that is generated by the head unit 106. At step 502, the user or driver of the vehicle adjusts the balance setting for the selected passenger category. Once the balance settings are adjusted, the audio output signals may be reproduced on the speakers 108, 110 according to the balance settings that are supplied by the user for that category, as is illustrated at step 504.

Fig 6 depicts yet another embodiment including a multi-channel audio system 600 for use in a vehicle. The multi-channel audio system 600 includes a plurality of audio sources 102 that are connected to an amplifier 104 and a head unit 106. The head unit 106 is also connected to the amplifier 104. A passenger category selection module 602 located on the head unit 106 is used to allow a user to select a passenger category. An audio manager module 114 located on the head unit 106 is used for adjusting a balance setting of a plurality of speakers 108, 110 for the selected passenger category based on a respective audio source 102 that generates an audio output signal.

[26] The user may select a passenger category to correspond to seating locations in the vehicle. As such, the passenger categories that may be selected to include, for example, a driver category, a passenger category, and a children category. The passenger category selection module 602 allows the user to navigate through a balance setting GUI 200 that is generated for each passenger category in a similar manner set forth above. After the user selects a passenger category, the balance

setting GUI 200 for that particular passenger category may be used to adjust the balance settings for the audio sources as with previous embodiments. Once the balance settings are set by the user, the predefined user balance settings are stored in the head unit 106. Unless the balance settings are adjusted again, each time the multi-channel audio system 600 is turned on the head unit 106 will revert to the saved balance settings.

[27] As set forth above, some of the audio output signals may be driver information messages that are generated by the navigation system. The audio signals from other audio sources may be muted or reduced when driver information messages are generated and played to occupants of the vehicle. The audio signals may be muted or reduced in the speaker nearest the driver of the vehicle, or in any combination of speakers.

[28] While various embodiments of the invention have been described, it will be apparent to those of ordinary skill in the art that many more embodiments and implementations are possible within the scope of the invention. Accordingly, the invention is not to be restricted except in light of the attached claims and their equivalents.

## CLAIMS

**What is claimed is:**

1. An audio system for use in a vehicle, comprising:  
5 a plurality of audio sources connected to an amplifier, where the audio sources are operable to generate a plurality of audio output signals that are supplied to the amplifier; and  
a control unit connected with the amplifier for adjusting a balance setting associated with a plurality of speakers based on each of the respective audio sources that generates the audio output signal, where the control unit includes a user interface  
10 for setting the balance setting of each audio source, where the control unit further adjusts the balance setting based upon a user preference for each audio source.
2. The audio system of claim 1 where the balance setting is further adjusted to  
15 output an acoustic driver information message to a speaker positioned near a driver of the vehicle.
3. The audio system of claim 2 where audio output signals from other audio  
20 sources are muted from the speaker positioned nearest the driver while the acoustic driver information message is being played on the speaker positioned nearest the driver.
4. The audio system of claim 2 where audio output signals from other audio  
25 sources play uninterrupted by the acoustic driver information message in at least one speaker not positioned nearest the driver.
5. The audio system of claim 4 where the acoustic driver information message is  
30 muted from the audio output signals sent to the speakers not positioned nearest the driver.

6. The audio system of claim 1 where the control unit includes an audio manager module operable to control the balance setting of the amplifier connected to the speakers.

5 7. The audio system of claim 1 where the control unit includes a means for adjustment operable to allow a user to adjust the balance setting of the audio sources.

8. The audio system of claim 1 where the control unit includes a user interface module operable to allow a user to adjust the balance setting of the audio sources using a touch-screen display.

10 9. The audio system of claim 8 where the user interface module generates a balance setting graphical user interface on the touch-screen display that allows a user to adjust the balance setting.

15 10. The audio system of claim 1 where the balance setting for each respective audio source is stored in the control unit.

20 11. The audio system of claim 1 where the audio source may be selected from a group of audio sources including a navigation system, a tuner, a remote terminal, a compact disc player, a digital video disc player, an MP3 player, a radio data service tuner, a television, a satellite radio, an Internet radio, a cassette player, and a text-to-speech system.

25 12. A computer program product for use with an audio system in a vehicle, comprising:

computer readable program code for controlling a plurality of audio sources capable of generating a plurality of audio output signals; and

30 computer readable program code for allowing a user to set a balance setting for a plurality of speakers for each respective audio source with a user interface.

13. The computer program product of claim 12, further comprising computer readable program code for audibly reproducing the audio output signals on the speakers based upon the respective balance setting of each of the audio sources.

5 14. The computer program product of claim 12 where at least one audio output signal comprises an acoustic driver information message generated from a respective audio source.

10 15. The computer program product of claim 14 where the respective audio source comprises a navigation system.

15 16. The computer program product of claim 14 where the balance setting generates the acoustic driver information message in a speaker nearest a driver of the vehicle.

17. The computer product of claim 15 where the balance setting reduces audio output signals from audio sources other than the navigation system.

20 18. The computer program product of claim 15 where the balance setting mutes audio output signals from audio sources other than the navigation system in the speaker nearest the driver of the vehicle.

25 19. The computer program product of claim 12 where the speakers comprise a front and rear set of loudspeakers.

20. The computer program product of claim 12, further comprising computer readable program code for generating a graphical user interface on a display capable of allowing the user to adjust the balance setting.

30 21. The computer program product of claim 12 where the audio sources may be selected from a group of audio sources including a navigation system, a tuner, a remote terminal, a compact disc player, a digital video disc player, an MP3 player, a

radio data service tuner, a television, a satellite radio, an Internet radio, a cassette player, and a text-to-speech system.

22. The computer program product of claim 12, further comprising computer readable program code for setting the balance setting for each audio source based on a passenger category.

23. The computer program product of claim 22 where the passenger category may include a driver, a co-driver, at least one child, or at least one adult passenger.

24. An audio system for a vehicle, comprising:  
a plurality of audio sources capable of generating a plurality of audio output signals;  
an amplifier connected to the audio sources for receiving the audio output signals generated by the audio sources;  
a plurality of speakers connected to the amplifier; and  
a head unit connected to the amplifier operable to control a balance setting of the speakers for each respective audio source that is generating the audio output signals, where the head unit is operable to generate a user interface for setting the balance setting of each audio source.

25. The audio system of claim 24 where the amplifier includes a balance setting circuit that is controlled by the head unit.

26. The audio system of claim 24 where the head unit includes a user interface module for allowing a user to adjust the balance setting of each audio source.

27. The audio system of claim 24 where the user interface is generated on a touch-screen display.

28. The audio system of claim 24 where the head unit includes an audio manager module operable to control the amplifier based upon the balance setting for each respective audio source.

5 29. The audio system of claim 24 where one audio source comprises a navigation system for generating an acoustic driver information message and the balance setting is set to audibly reproduce the acoustic driver information message only in a respective speaker positioned near a driver of the vehicle.

10 30. The audio system of claim 29 where other audio sources continue in a predetermined number of other speakers uninterrupted by the acoustic driver information message.

15 31. The audio system of claim 24 where the audio sources may be selected from a group of audio sources including a navigation system, a tuner, a remote terminal, a compact disc player, a digital video disc player, an MP3 player, a radio data service tuner, a television, a satellite radio, an Internet radio, a cassette player, and a text-to-speech system.

20 32. A method of controlling balance settings in an audio system for a vehicle, comprising the steps of:

generating a plurality of audio output signals from a plurality of audio sources;  
transmitting the audio output signals from the audio sources to an amplifier;  
adjusting a balance setting of each respective audio source with a head unit  
25 connected to the amplifier; and

reproducing the audio output signals on a speaker based upon the balance setting of each respective audio source.

30 33. The method of claim 32 where the balance setting of each audio source is adjusted by an occupant of the vehicle with a graphical user interface.

34. The method of claim 32 where the graphical user interface includes a vertical and horizontal scroll bar for adjusting the balance setting.

35. The method of claim 33 where the graphical user interface is generated on a touch-screen display in the vehicle.

36. The method of claim 32 where a respective audio output signal comprises an acoustic driver information message generated by a navigation system.

37. The method of claim 36 where the balance setting is positioned such that the acoustic driver information message is reproduced on a speaker chosen by the driver.

38. The method of claim 32 where the audio sources may be selected from a group of audio sources including a navigation system, a tuner, a remote terminal, a compact disc player, a digital video disc player, an MP3 player, a radio data service tuner, a television, a satellite radio, an Internet radio, a cassette player and a text-to-speech system.

39. An audio system for use in a vehicle comprising:  
a plurality of audio sources connected to an amplifier;  
a control unit connected to the amplifier;  
a passenger category selection module located on the control unit for selecting a passenger category; and

a user interface module located on the control unit for adjusting a balance setting of a plurality of speakers for the selected passenger category based on a respective audio source that generates an audio output signal.

40. The audio system of claim 39 further comprising an audio manager module for controlling the amplifier to audibly reproduce the audio output signal in a predetermined number of speakers based upon the balance setting for each of the audio sources.



41. The audio system of claim 39 where the passenger category selection module is operable to generate a balance setting graphical user interface that is used to adjust the balance settings of the audio sources.

5 42. The audio system of claim 39 where the passenger category may be selected from a group of passenger categories including a driver category, a co-driver category, a backseat passenger category and a children category.

10 43. A method of controlling balance settings in an audio system for a vehicle, comprising the steps of:

selecting a passenger category;

adjusting a balance setting of at least one audio source for the passenger category; and

15 reproducing audio output signals based on the balance setting for each audio source.

20 44. The method of claim 43 where the passenger category is selected through a graphical user interface generated by a passenger category selection module located on the control unit.

45. The method of claim 43 where the passenger category may be selected from a group of passenger categories including a driver category, a co-driver category, a backseat passenger category and a children category.

25 46. In a vehicle navigation system having a graphical user interface including a display and selection device, a method of providing and selecting from a menu on the display, the method comprising:

30 retrieving a set of menu entries associated with the menu, where each of the menu entries represents at least one balance setting associated with each one of a plurality of audio sources;

displaying at least one of the balance settings associated with each audio source;

receiving a menu entry selection signal indicative of the selection device pointing at a selected menu entry associated with the balance setting from the set of menu entries; and

in response to the menu entry selection signal, adjusting the balance setting associated with the audio source as indicated by the menu entry selection signal.

47. The method of claim 46 where the display and selection device comprise a touch-screen display.

48. The method of claim 47 where a horizontal and vertical scroll bar generated on the touch-screen display are used to adjust the balance setting of each audio source.

49. The method of claim 46 further comprising the step of reproducing audio output signals on a plurality of speakers using the balance setting provided for each audio source.

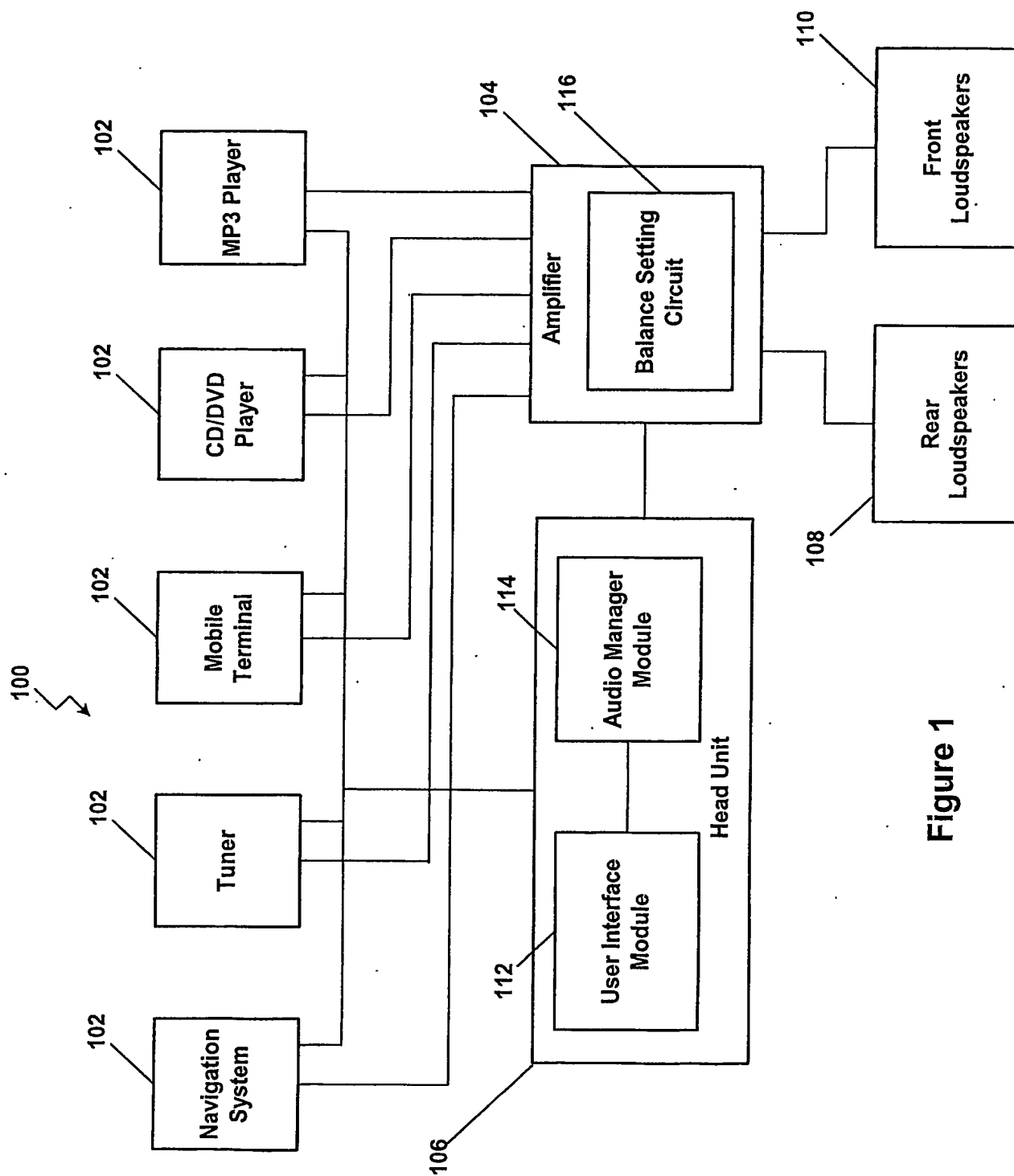


Figure 1

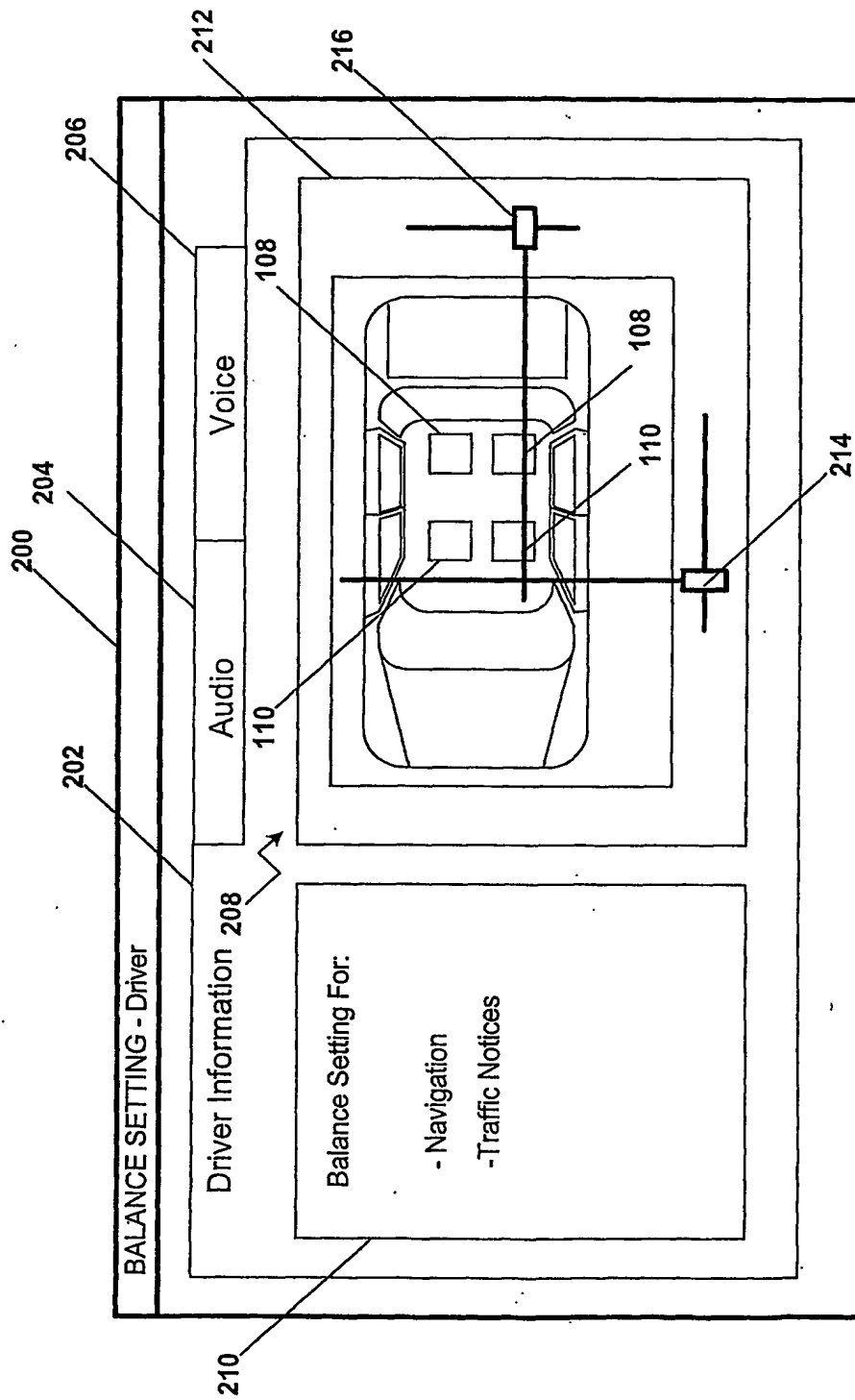


Figure 2

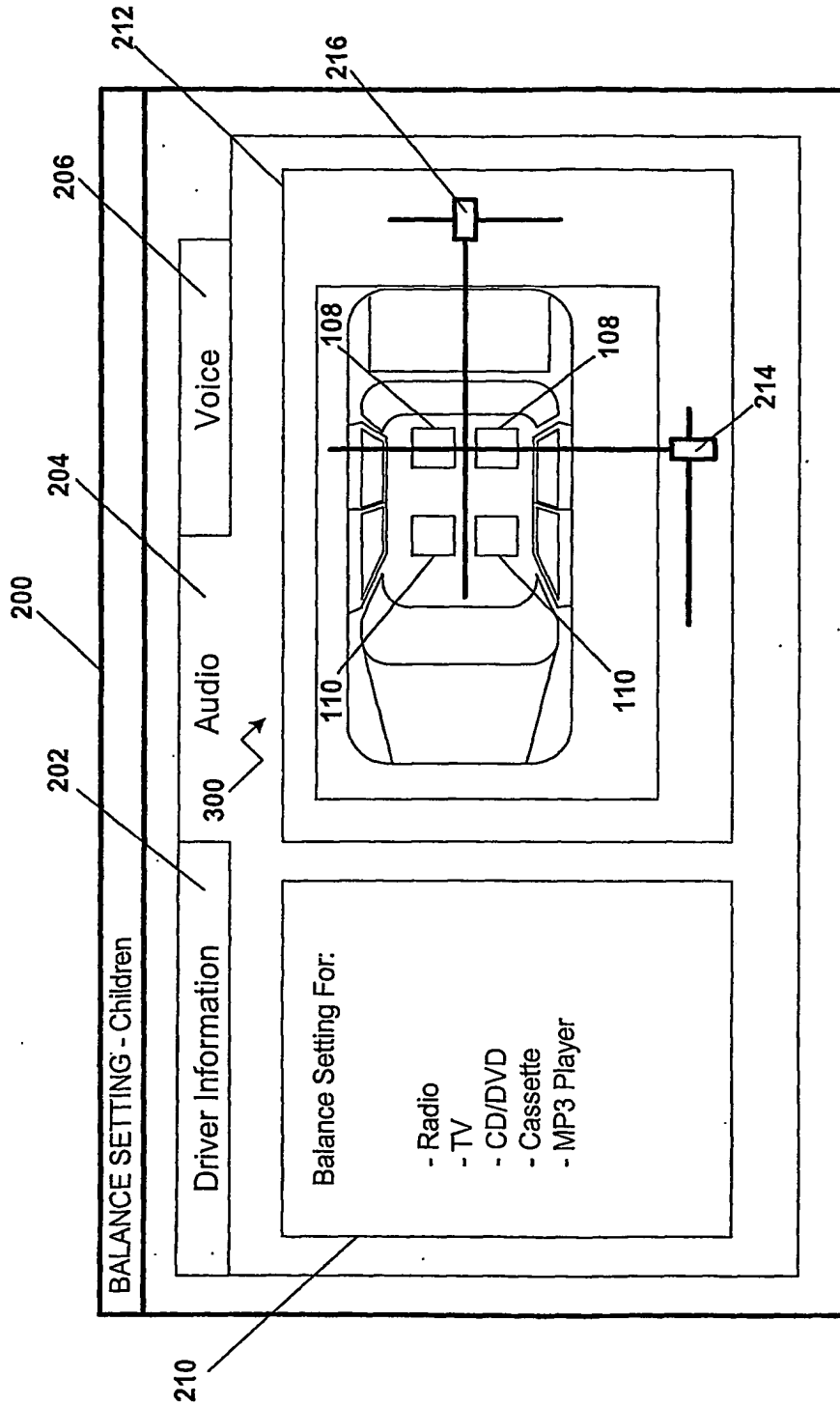
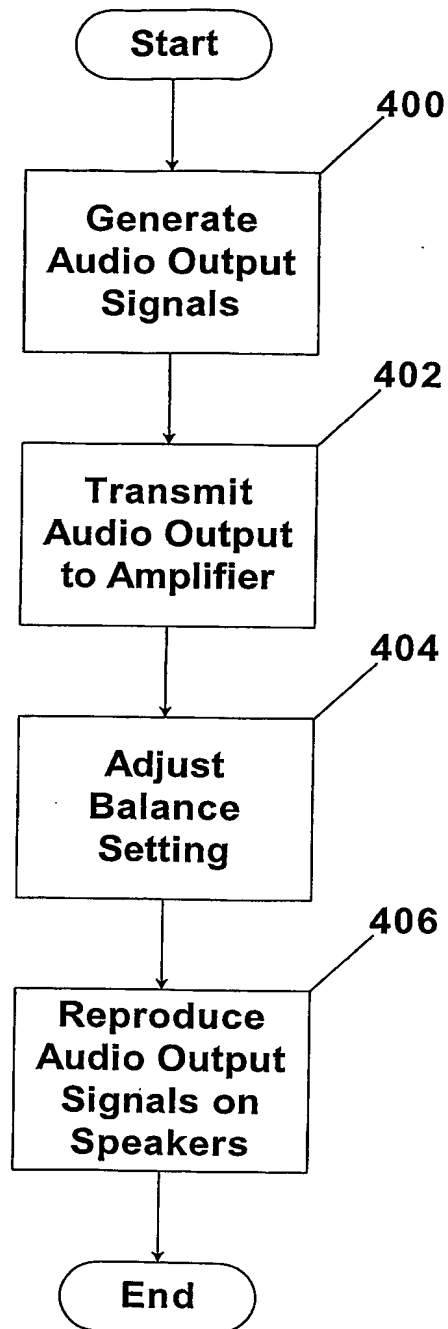
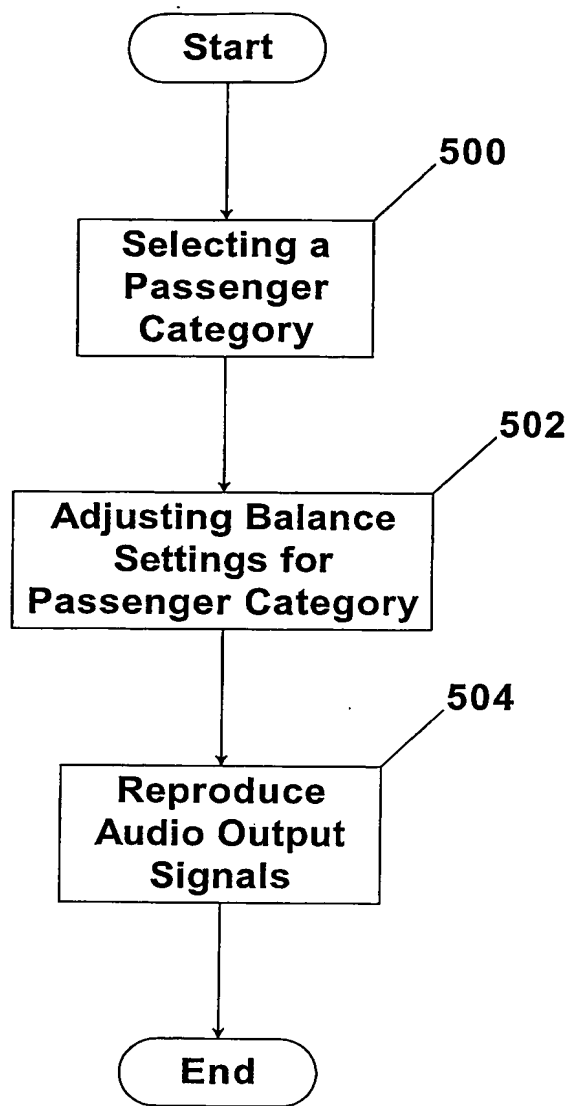


Figure 3

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**Figure 4**

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**Figure 5**

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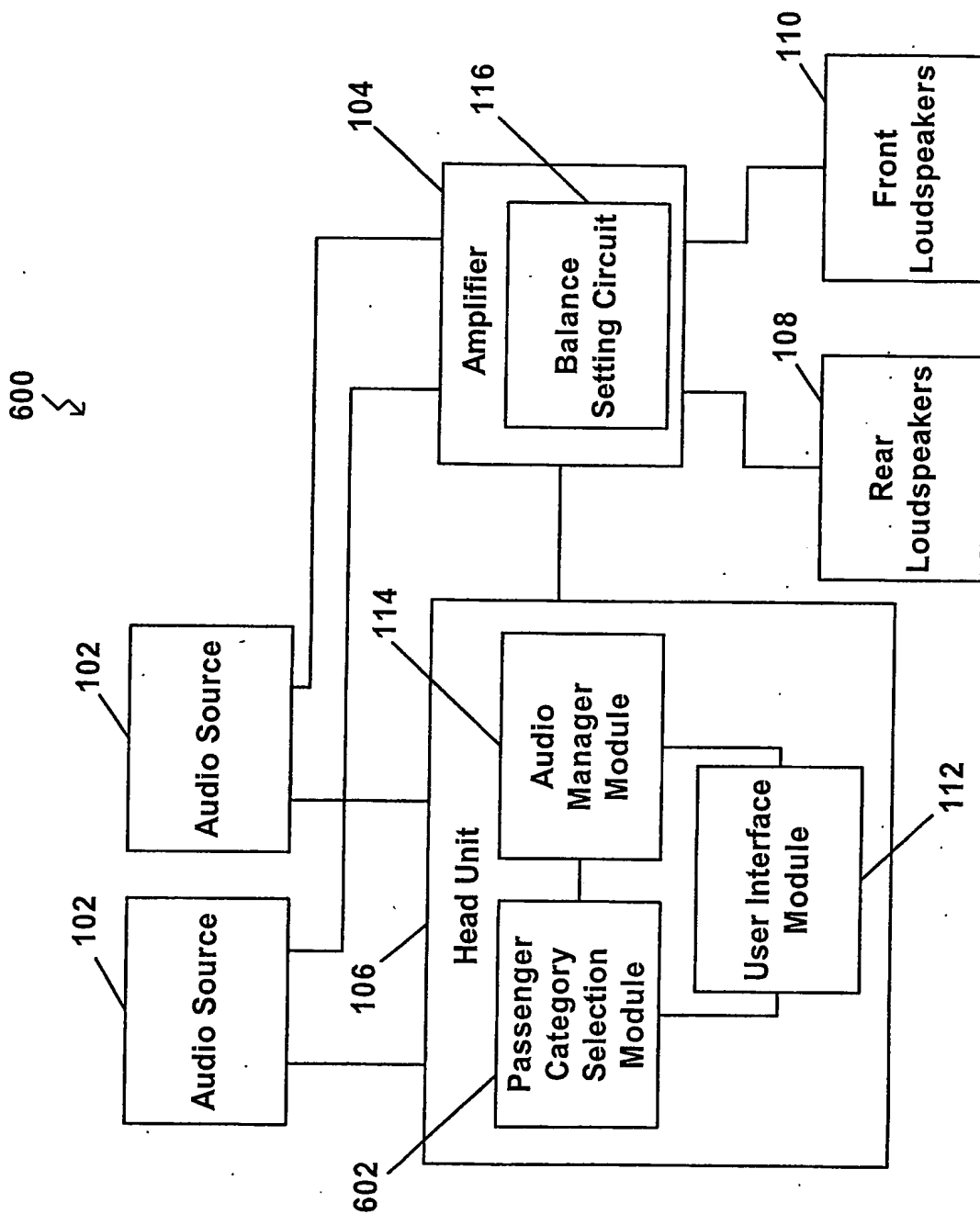


Figure 6



## INTERNATIONAL SEARCH REPORT

International application No.

PCT/US03/01932

## A. CLASSIFICATION OF SUBJECT MATTER

IPC(7) : H04B 1/00, 3/00; H03G 3/00; H03F 21/00

US CL : 381/86, 77, 80, 81, 104, 107, 109, 120

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 381/86, 77, 80, 81, 104, 107, 109, 120

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched  
NONEElectronic data base consulted during the international search (name of data base and, where practicable, search terms used)  
NONE

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 6,114,774 A (FIEGURA) 05 SEPTEMBER 2000, fig. 7.	1-49
Y	US 6,157,725 A (BECKER) 05 DECEMBER 2000, fig. 1.	1-49
Y	US 5,661,811 A (HUEMANN et al) 26 AUGUST 1997, figs. 1-2.	1-49
Y	US 5,745,583 A (KOIZUMI et al) 28 APRIL 1998, fig. 1.	1-49

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:	"I" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A" document defining the general state of the art which is not considered to be of particular relevance	"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"E" earlier document published on or after the international filing date	"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"&" document member of the same patent family
"O" document referring to an oral disclosure, use, exhibition or other means	
"P" document published prior to the international filing date but later than the priority date claimed	

Date of the actual completion of the international search

23 MARCH 2003

Date of mailing of the international search report

14 APR 2003

Name and mailing address of the ISA/US  
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# INTERNATIONAL SEARCH REPORT

International application No.  
PCT/US03/01932

## Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This international report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:  
because they relate to subject matter not required to be searched by this Authority, namely:
  
2. ☐ Claims Nos.:  
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
  
3. ☐ Claims Nos.:  
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

## Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
  
4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest.  
☐ No protest accompanied the payment of additional search fees.